

Healthy Forests in the South:

Challenges for the 21st Century

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The health of forests in the Southeastern United States, as elsewhere in the country, is tied closely to the history of human presence on the land and the use and abuse of its abundant natural resources. In his discussion of the relationship between forest condition and the Native American presence in the Southeast, Rauscher (this book) makes two points. Firstly, the forests of 500 years ago are believed to have been very different from the forests of today. Forests were more open, and their condition was maintained by Native American fires. Secondly, once Native American populations were significantly reduced by disease, the forests began to change, becoming more dense and stratified. It is clear that few, if any, plants, animals, or microbes from other continents were present in North America before it was settled by Europeans. Whereas large segments of Native American populations were wiped out by foreign diseases within 100 years of European settlement on the continent, the effect of this settlement on Native American vegetation was less immediate, beginning in earnest in the middle to late 1800s, and continuing today.

The condition of precolonial southeastern forests and the changes to plant community structure that resulted from harvesting and the introduction of nonnative plants, animals, and microbes have been well summarized (Owen 2002). Owen (2002) lists several nonnative diseases, insects, and plants—including chestnut blight [*Cryphonectria parasitica* (Murrill) Barr [formerly *Endothia parasitica* (Murrill) Anderson & Anderson]], Dutch elm disease [*Ophiostoma ulmi* (Buisman) Nannf.], butternut canker [*Sirococcus clavignenti-juglandacearum*

(N.B. Nair, Kostichka & Kuntz)], white pine blister rust [*Cronartium ribicola* (J.C. Fisch)], gypsy moth [*Lymantria dispar* L.], balsam woolly adelgid [*Adelges piceae* (Ratzeburg)], Japanese honeysuckle [*Lonicera japonica* Thunb.], and cogon grass [*Imperata cylindrica* (L.) Beauv.]—that have altered southeastern forests considerably and which continue to affect the biology of these forests. Those interested in learning more about these and other introduced pathogens, insects, and plants may start with volumes by Tainter and Baker (1996), Anon. (1985), and Miller (2003).

Much of the research and management effort of foresters, plant pathologists, entomologists, and weed scientists during the 20th century was directed to learning the bionomics of nonnative species, trying to contain their spread, and restoring ecosystems altered by their presence. Unfortunately, there have been few successes in controlling the advance of, and the damage caused by, most introduced species; and so the next generation of scientists and forest land managers will face growing challenges. In addition, forest health concerns in the South have expanded over the last several decades to include native and nonnative invasive insects, pathogens, and plants; disease complexes; urbanization; forest fragmentation; air pollutant effects; and increased risk of wildfire. Recently discovered nonnative insects, such as the Asian longhorned beetle [*Anoplophora glabripennis* (Motschulsky)] and the emerald ash borer [*Agrilus planipennis* (Fairmaire)], as well as the recently discovered nonnative disease sudden oak death [*Phytophthora ramorum* Werres], while not currently known to be in southeastern forests, present a threat to our forests because they are known to damage tree species endemic to the Southeast. Continued novel research and the development of new monitoring techniques offer the best hope for restoring and maintaining the health of southeastern forests.

In the opening years of the 21st century, as in those of the 20th century, concern about the health of the Nation's forests has influenced policy at the highest levels of the Federal Government. The Healthy Forest Initiative, announced in August

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2002 by President George W. Bush, directed Federal agencies to develop administrative and legislative measures that will help reduce the threat of catastrophic wildfire to America's forests and rangelands (Anon. 2003a). The U.S. House of Representatives responded by passing H.R. 1904, the Healthy Forests Restoration Act of 2003. While the Administration's intent was to allow greater flexibility in dealing with emergency situations, especially wildfires, through a reduction in complex procedures and by providing for more rapid decisionmaking, forest preservationists were concerned that revised rules would lead to indiscriminate clearcutting of the national forests.

As was the case 100 years ago, foresters and forest health professionals were thrust into the midst of controversy and given the opportunity to inform intelligent and rational discussion. The Healthy Forests Restoration Act of 2003 was signed into law on December 3, 2003 at which time it fell primarily to Federal scientists and managers, especially within the U.S. Department of Agriculture Forest Service (Forest Service), to develop the means of carrying out the act's requirements. In addition to addressing the reduction of "risks to communities, municipal water supplies, and some at-risk Federal lands from catastrophic wildfires," the act also seeks to "promote systematic information gathering to address the impact of insect infestations on forest and rangeland health" and "to improve the capacity to detect insect and disease infestations at an early stage, particularly with respect to hardwood forests" (Anon. 2003b).

Title IV of the act addresses insect infestations and specifically mentions the need to

assist land managers in the development of treatments and strategies to improve forest health and reduce the susceptibility of forest ecosystems to severe infestations of bark beetles, including Southern pine beetles, hemlock woolly adelgids, emerald ash borers, red oak borers, and white oak borers on Federal lands and State and private lands; and to disseminate the results of such information gathering, treatments, and strategies.

Ten of the thirteen States served by the Southern Research Station are mentioned in connection with epidemic outbreaks of the southern pine beetle (*Dendroctonus frontalis* Zimmermann), a subject addressed by T. Evan Nebeker in this book, and Arkansas is cited as

having an unprecedented outbreak of the red oak borer [*Enaphalodes rufulus* (Haldeman)]. Most interesting in the legislation is language urging the development of a system that will give forest managers early warning of catastrophic environmental threats to forests, thereby increasing the likelihood that such threats can be isolated and treated before they get out of control; and to "prevent epidemics, such as the American chestnut blight in the first half of the twentieth century, that could be environmentally and economically devastating to forests" (Anon. 2003b). Clearly, social and political forces in the United States are keenly interested in forest health issues of stand management, wildfire suppression, and outbreaks of native and nonnative insects, diseases, and invasive weeds; all of which present tremendous challenges and opportunities to forest health professionals in the 21st century.

The development of appropriate research and management responses begins by asking the right questions, so that needs can be determined based on the most important and immediate resource management concerns. Forest Service Research and Development asked the right questions in the report "Great Issues, New Solutions: A Summary of Forest Service Research Addressing the Four Great Issues," which was a response to the Healthy Forests Initiative. In the report, members of the Forest Service Research and Development staff in Washington, DC, enumerated the successes and ongoing research and development of scientists in the Agency's six research stations, Forest Products Laboratory, and Institute of Tropical Forestry (Anon. 2003c). They also asked questions that range from the more general, such as, "How do nonnative species invasions affect community structure, trophic interactions, and disease dynamics?" and "How do microbial organisms affect the environment?" to the quite specific, such as, where changes have been nearly irreversible, e.g., American chestnut [*Castanea dentata* (Marsh.) Borkh.], "How can we reestablish 'native' hybrids to restore forest values?" and "How do insects and pathogens affect fuel dynamics and flammability?" Some questions concern the management of ecosystems. Examples of these are, "How do natural and human disturbance processes and their interactions impact and shape ecosystems?" "How do fire, insects, and disease affect long-term productivity and carbon dynamics of ecosystems?" "How can we restore and maintain the health and productivity of disturbed ecosystems?" and "What is the potential for management intervention?"

Other questions relate to monitoring capabilities. Examples of these are, “Can we develop a quick response capability that provides essential scientific knowledge to help managers isolate new invasive species before they become established?” and “What methods can be developed to monitor and assess noxious weed impacts?” These, and a host of other related questions, will drive much of the work of forestry researchers and managers at the beginning of the 21st century.

Chapters in this section of our book address some of the more pressing issues of forest and ecosystem restoration, nonnative invasive pests, and native insects and diseases in ever-changing climatological, social, and political environments. The second chapter “Restoration of Southern Ecosystems” by John Stanturf, Emile Gardiner, Kenneth Outcalt, William Conner, and James Guldin presents an overview of restoration efforts in four ecologically varied and socially valued southern forest types. The authors observe that methods for restoration are more advanced for bottomland hardwoods and longleaf pine (*Pinus palustris* Mill.) forests than for deepwater swamp and shortleaf pine (*P. echinata* Mill.) forests. Bottomland hardwood restoration occurs mostly on private land; restoration of deepwater swamps and shortleaf pine forests occurs mostly on public land; and both private and public landowners are working to restore longleaf pine. Ownership has implications for the economics of forest land restoration. For example, current Federal programs that provide large easement payments, such as the Wetlands Reserve Program, are expensive and probably justified on poor sites. On better sites, restoration might pay for itself, with only cost sharing needed to establish the forest.

Stanturf, Gardiner, Outcalt, Conner, and Guldin emphasize that forests are resilient and that forest habitats will develop whether or not we intervene. The best we can do is to establish initial conditions that foster development of a forest appropriate to the site and present conditions. Attempts at re-creating ancient forests are likely to fail, because the conditions under which such forests developed cannot be replicated.

The third chapter of this section “Understanding and Controlling Nonnative Forest Pests in the South” by Kerry O. Britton, Donald A. Duerr, II, and James H. Miller discusses nonnative diseases, insects, and plants that have caused drastic changes in southeastern forest ecosystems and have cost a lot of money for management, containment, and research. The authors discuss

the biological basis for the invasiveness of nonnative pests and what can be done about these pests. Included at the end of the discussion is a listing of Internet Web sites that are examples of a form of late 20th-century technology transfer that will undoubtedly endure, and be improved upon, in the current century.

The fourth chapter “Advances in the Control and Management of the Southern Pine Bark Beetles” by T. Evan Nebeker addresses recent advances in the control and management of native southern pine bark beetles and the outlook for future management. Nebeker also refers to several Web sites as examples of ways entomologists are distributing critically needed information about bark beetles and methods for controlling them. One of the changes Nebeker forecasts is that forest resource protection of the future will be aimed more at prevention of damage through the development and use of hazard- and risk-rating expert systems.

The fifth chapter “The Impact and Control of Major Southern Forest Diseases” by A. Dan Wilson, Theodor D. Leininger, William J. Otrrosina, L. David Dwinell, and Nathan M. Schiff discusses the ongoing work to discover novel control methods for several hardwood and coniferous diseases that continue to beset forests of the Southeast. Tree diseases continue to present challenges for pathologists and forest managers even as we enter the second century after the father of forest pathology, Robert Hartig, wrote the first forest pathology textbook in 1874 (Tainter and Baker 1996). One of the findings of the Southern Forest Resource Assessment (Wear and Greis 2002) was that more forest land in the eastern part of the southeastern region will be converted to pine plantations, while new hardwood forests will be created on former agricultural land in the western portion of the region. Management of these forests that lack diversity of tree species, as well as third- and fourth-growth natural stands, will present many challenges to forest health researchers and forest managers. These challenges will need to be overcome in the midst of changing climatological and sociopolitical environments that will mean understanding and addressing dynamic ecological variables with smaller budgets and fewer people.

The sixth chapter “Monitoring the Sustainability of the Southern Forest” by Gregory A. Reams, Neil Clark, and James Chamberlain discusses how monitoring efforts have been modified and implemented to specifically address

the evolving forest health concerns in the South, which now include native and nonnative invasive insects, pathogens, plants, plant-disease complexes, urbanization, fragmentation, air pollutant effects, and wildfire risk. Significant adaptations to the Forest Service's Forest Inventory and Analysis (FIA) sampling design have been made to accommodate monitoring needs of the Forest Health Monitoring (FHM) Program. These needs include the requirement to provide for early detection monitoring to evaluate status and change in forest conditions. To provide this function, FHM detection monitoring is now integrated with the new continuous (annual) forest inventory design currently being implemented by FIA.

The FIA Program has been in place since the 1930s and has reported changes in forested acres, forest type, growth, mortality, and harvest by State on a 6- to 10-year cycle since the program's inception. The current modifications to the FIA and FHM Programs are an outgrowth of the National Acid Precipitation Assessment Program (NAPAP) and the National Vegetation Survey (NVS). Both NAPAP and NVS employed FIA field plots in their surveys of acid rain and ozone impacts on forests. The use of FIA plots to do forest health monitoring under NAPAP led to the formation of FHM.

Initial FHM objectives focused on air pollution impacts on forests. However, since the early 1990s the program has expanded analysis and reporting capabilities to include criteria and indicators of sustainable forest management as identified in the Montreal Process. Specifically, FHM addresses conservation of biodiversity, maintenance of forest ecosystem health, and maintenance of soil and water resources by sampling additional indicators of forest health on an annual subset of FIA ground plots. The forest health indicators include crown condition, ozone injury, lichen communities, down woody debris, vegetation diversity and structure, and soil condition.

Detection monitoring data are used as an early warning system to decide whether implementation of evaluation monitoring is warranted to determine the extent, severity, and causes of undesirable changes. The development of novel and adaptive sampling techniques is also part of the FHM Program. Risk-based sampling is being used for early detection of sudden oak death and emerald ash borer. Eventually, risk-based and adaptive sampling techniques will become universal elements of any large-scale early detection program.

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